Beginning of

The contribution of the new physics to religious thought

This title was preceded by

The Jesus of history reinterpreted for today

A critical evaluation of the contributions of Professor Benjamin W. Bacon to the interpretation of the fourth gospel

Predestination and incarnation

The social and religious origins of the Negro Church

Search by above titles on archive.org to continue reading this collection of Pacific School of Religion Theses from 1935 call number Thesis Cage 1935 v.4

Digitized by the Internet Archive
in 2025 with funding from
Graduate Theological Union

https://archive.org/details/contributionofne00unse

The Contribution of the New Physics to Religious Thought

by

Paul Faulkner Tjensvold

B.A. University of California 1928

B.D. Pacific School of Religion 1932

Thesis

Submitted in the Department of the Philosophy of Religion in partial fulfilment of the requirements for the degree of Master of Sacred Theology in the Pacific School of Religion

1935

The Contribution of the New Physics to Religious Thought

Chapter I: Relativity, Possibility and the Fall of Scientific Dogmatism (1)

Chapter II: The Symbolic Nature of Science (23)

Chapter III: The Quantum Theory and the Principle of Causality

Chapter IV: Time Entropy and Events

Chapter V: Mathematics and Mind Stuff (66)

Chapter VI: Science, Religion and Mysticism (75)

Chapter VII: Philosophical Systems as Influenced by the New Physics (85)

The Contribution of the New Physics to Religious Thought

Chapter I

Relativity, Possibility, and the Fall of Scientific Dogmatism

I: "Scripture says that the sun moves and the earth is stationary, and science that the earth moves and the sun is comparatively at rest. How can we determine which of these opposite statements is the very truth till we know what motion is? If our idea of motion is but an accidental result of our present senses, neither proposition is true and both are true: neither true philosophically; both true for certain practical purposes in the system in which they are respectively found." (1)

The above excerpt from the writings of Cardinal John Henry Newman is quoted by Andrew D. White as one of the most sceptical passages in all literature, and is again quoted in Upton Sinclair's "Profits of Religion" (2) as a horrible example of clerical obscurantism. Now without any intention of denying that Newman was basicly a sceptic, or that his defense of the Biblical revelation was worthless, yet it must be said that this particular passage does not sound as silly today in the light of the theory of Relativity as it did when it was first offered.

The Theory of Relativity

The modern doctrine of relativity really starts with the Michelson-Morley experiment. If light were coming in our direction at 186,000 miles per second, and we were going toward the light at a speed of 100,000 miles per second, then it would seem to be clear that the light would be passing us at a speed of 286,000 miles per second; but if we were going away from the light at 100,000 miles per second, then the light would be passing us at only 86,000 miles per second. Here is a perfectly good theory, and in the Michelson-Morley experiment an attempt was made to measure the absolute speed of the earth by the speed of travel of light. The strange result was that light was discovered to move at the same speed, or at least that although the apparatus was delicate enough to measure the difference yet no difference could be measured. This result was absolutely inexplicable on the basis of the old classical Physics, and was the original basis of Einstein's theory of Relativity. This theory was also able to explain

certain peculiarities in the orbit of Mercury. According to it light passing by large masses of matter would be deflected, and this has since been experimentally validated by the displacement of stars in photographs taken at the time of total eclipses of the sun.

The Theory of Relativity is too abstruse for us to go into carefully, but among other things, it means that there is no absolute frame of reference in space, that time and space have resolved themselves into a four dimensional continuum, and that as Professor Hans Reichenbach says

> "the conceptual world of moderate dimensions has no validity in respect of large-scale worlds. In the large-scale world, where we investigated the doctrine of time and space, we found this idea realized in the passage from euclidian geometry to the much more complicated conceptions of non-euclidian geometry." (3)

It might be said in passing that probably the word "unusual" could best be substituted for the word "complicated" in the above, for Einstein insists that the new way of looking at things is really much simpler for one who understands both ways.

II: Non-Euclidian Geometry

In Einstein's Theory empty space corresponds closely with the conceptions of euclidean geometry, as we studied them in high school, but in those parts of space where there is much matter, space itself is twisted, so as to act in accordance with the Riemannian type of non-euclidian geometry. This first non-euclidian geometry, that of Lobachevski was discovered in 1828, and the new mathematics was largely the cause of the New Reformation in Physics, as well as something given importance by that Reformation. The nature of non-euclidian geometry may best be brought out in the words of Bertrand Russell:

> "The mathematicians.... have not been content with showing that space as it is commonly supposed to be is possible; they have shown also that many other forms of space are equally possible, so far as logic can show. Some of Euclid's axioms, which appear to common sense to be necessary and were formerly supposed to be necessary by philosophers are now known to derive their appearance of necessity from our mere familiarity with actual space, and not from any a priori logical foundations. By imagining worlds in which these axioms are false, the mathematicians have used logic to loosen the prejudices of common sense, and to show the possibility of spaces differing-- some more, some less-- from that in which we live. And some of these spaces differ so little from euclidian space, where distances such as we can measure are concerned, that it is impossible to discover

by observation whether our actual space is strictly euclidian or of one of these other kinds. Thus the position is completely reversed. Formerly it appeared that experience left only one kind of space to logic, and logic showed this one kind to be impossible. Now logic presents many kinds of space as possible apart from experience, and experience only partially decides between them. Thus while our knowledge of what is has become less than it was formerly supposed to be, our knowledge of what may be is enormously increased". (4)

The Dethronement of the A Priori

Such a radical change could not help but have radical consequences in the realm of Philosophy. One of the main consequences is the dethronement of the a priori. For instance, in the philosophy of mathematics it was formerly held (by Kant especially) that the bases of mathematics were a priori. John Stuart Mill came to the view that the bases of mathematics were empirical. Most modern students of the philosophy of mathematics would be even more radical than Mill, and would claim that the bases are pure assumptions. And this dethronement of the a priori will not remain only in the realm of mathematics. As Russell says in general:

"The attempt to prescribe to the universe by means of a priori principles has broken down; logic, instead of being, as formerly, the bar to possibilities, has become the great liberator of the imagination, presenting innumerable alternatives which are closed to unreflective common sense, and leaving to experience the task of deciding, where decision is possible, between the many worlds which logic offers to our choice. Thus knowledge as to what exists becomes limited to what we can learn from experience-- not to what we can actually experience, for as we have seen, there is much knowledge by description concerning things of which we have no direct experience." (5)

In his "A.B.C. of Relativity", Russell expresses the same idea:

"Propositions which used to be proved by reasoning have now become either conscientious, or merely approximate truths verified by observation.

"It is a curious fact-- of which relativity is not the only illustration --that as reasoning improves, its claims to the power of proving facts grow less and less. Logic used to be thought to teach us how to draw inferences; now it teaches us rather how not to draw inferences." (6)

This dethronement of the a priori, and the cutting of the ground from under arguments based upon "necessity for thought", or "logical inconsistency" will necessarily affect the way in which theologians will phrase their conclusions, if it does not alter their content.

God as the Principle of Concretion

This idea of there being a vast number of alternatives, and of possibilities of existence carried over from mathematics into philosophy has had an interesting development in the thinking of Alfred North Whitehead. He calls these alternatives and possibilities "Eternal Objects", and says:

> "We conceive actuality as in essential relationship to an unfathomable possibility. Eternal objects inform actual occasions with hierarchic patterns, included and excluded in every variety of discrimination. Another view of the same truth is that every actual occasion is a limitation imposed on possibility, and that by virtue of this limitaion the particular value of that shaped togetherness of things emerges. In this way we express how a single occasion is to be viewed in terms of possibility, and how possibility is to be viewed in terms of a single actual occasion." (7)

In this system there is needed some one or something to choose which of the vast number of possibilities shall become actusl or concrete. As Whitehead says:

> "In place of Aristotle's God as Prime Mover, we require God as the Principle of Concretion." (8)

> "God is the ultimate limitation", (upon these possibilities) "and His existence is the ultimate irrationality. For no reason can be given for just that limitation which it stands in His nature to impose. God is not concrete but He is the ground for concrete

> actuality. No reason can be given for the nature of God, because that nature is the ground of rationality.... ..... The general principle of empiricism depends upon the doctrine that there is a principle of concretion which is not discoverable by abstract reason. What further can be known about God must be sought in the region of particular experiences, and therefore rests on an empirical basis". (9)

It must be admitted that at first sight God as the Principle of Concretion seems very abstract and very distant from Christian faith, and yet God the Principle of C oncretion is merely our old friend, God the Creator, thought of in a slightly different way, and given a slightly different name.

One still has the feeling that God as the Principle of Concretion is somewhat lacking in religious value. Perhaps it is also true that the older cosmic concepts of God are also lacking in religious value. Professor Le Roi comments on the classical proofs for the existence of God that they prove the wrong God. For the purposes of religion, it might appear that both God the Principle of Concretion and God the Prime Mover or the Creator are the wrong God. The God of religion is not so much a necessity for thought as He is a help to right living.

Possibility and Providence

However it does seem to me that this idea of God as the determiner of which of the vast number of possibilities shall become concrete, could be a help to the imagination, in thinking of how an overruling Providence could be possible, in connection with the freedom of the will.

If there are a vast number of equally perfect plans for a single human life, the free decision of the individual might only result in shifting the course of his life from one perfect possible plan to another equally perfect possible plan. It may be that it is still true that

"all things work together for good to them that love God, to those who are called according to his purpose".

If these views were correct human beings also would be minor "Principles of Concretion".

Relativity and Multiple Points of View

The aspect of Relativity that especially appeals to Walter Marshall Horton is that "

"the principle of relativity implies the legitimacy and necessity of multiple points of view". (10)

He says that the

"measuring tools and concepts devised for our ordinary medium sized world are inadequate for dealing with the world of the atoms and the world of the island universes". (11)

However, he says that the new discoveries

"have undermined and destroyed the scientific dogmatism of the late nineteenth century, making its materialism and mechanism as obsolete as witchcraft". (12)

Relativity makes clear

"the legitimacy and necessity of multiple points of view and multiple approaches to reality, and the ultimate need of squaring all such points of view and all such approaches with the direct experience of the ordinary man". (13)

Again he says:

"...the Principle of Relativity....means simply the impossibility of discovering the whole truth about the universe with any one set of concepts or measuring rods, and the necessity of varying one's point of view endlessly if one is to become aware of the rich complexity of the world as it really is". (14)

Furthermore, it would appear as if the God of religion and the God of reason must be the same reality looked at from different points of view, and it is often valuable to have more than one way of looking at a thing. Even in the case of so simple a thing as the human eye, the fact that we have two eyes instead of one is a great help in

judging distance. Who would want to deny that our conception of God is richer because we conceive of Him as Creator as well as the Author of the Moral Imperative?

Paradoxes in Physics

It might be remarked that this need for varied approaches comes to light in other realms of the exact sciences, besides the Principle of Relativity. For instance, is light "particles" or "waves"? Some kinds of behavior of light can be explained on a basis that it is particles but not on a basis that it is waves. Others on the basis that it is waves, but not on a theory of particles, whereas most properties of light could be explained upon either basis. In such a case, science has to treat light as both particles and waves, well aware as it is of the paradox and contradiction involved, until it discovers some more basic category which will absorb both. As a matter of fact all the known behavior of light can be described in terms of mathematical formulae alone.

Again Eddington says that

"One of the greatest puzzles of science is to discover why

protons and electrons are not simply the opposites of one another, although our whole conception of electric charge requires that positive and negative electricity should be related like + and - ". (15)

In logic, as Whitehead points out, contradiction is a sign of failure, but in practical science, it is an opportunity for learning more. And until we learn more, truth often resides in the paradox.

The Relativity of Religious Knowledge

Nor will Horton limit the necessity for multiple points of view to the realm of science. He says:

"We shall recognize that if scientific knowledge is relative, religious knowledge is also relative". (16)

Here in America, and influenced by this new knowledge, there has grown up a whole school of Religious Realists, and in France, Edouard Le Roi is a leading exponent of the point of view that

"...theological dogmas" (are) "only approximately or symbolically true in their theoretical sense". (17)

It is probable that this tendency to regard religious truth as relative will grow among theologians despite

the order of Rome for the tide to cease coming in, for Rome has already done its best to stop it.

> "Let him be anathema who shall say, 'Dogmas are to be held only according to their practical implication for conduct, that is, not as a rule of faith, but as a perceptual rule' ". (18)

IV: The Open-Mindedness of Modern Science

As Dr. John Wright Buckham points out, another factor besides the theory of Relativity has entered in to make science more humble, and less dog matic, and this is the great changes which have occurred in scientific doctrines. Dr. Buckham says:

> "Experience has taught the science of today to be more hesitant and open-minded. Too many revisions of former hypotheses have become necessary, too many incursions of unsuspected forces and factors have occurred to permit the science of today to indulge in theology's favorite vice of dogmatism." (19)

Turnings in the Stream of Knowledge

It is especially Sir James Jeans among the scientists who has been impressed with the need of open-mindedness,

because of the changes in scientific knowledge.

He closes his book on the "Mysterious Universe" with the statement:

".... our main contention can hardly be that the Science of today has a pronouncement to make, perhaps it ought rather to be that science should leave off making pronouncements; the river of knowledge has too often turned back on itself." (20)

Using the analogy of a river winding through a landscape to depict the changes in direction in scientific thought, Jeans says:

"No scientist who has lived through the last thirty years is likely to be too dogmatic either to the future course of the stream or as to the direction in which reality lies..." (21)
"...The river of knowledge has made a sharp bend in the last few years. Thirty years ago, we thought or assumed that we were heading towards an ultimate reality of a mechanical kind.....Today there is a wide measure of agreement which on the physical side of science approaches almost to unanimity, that the stream of knowledge is heading towards a non-mechanical reality; the universe begins to look more like a great thought than like a great machine." (22)
"...And yet who knows how many more times the stream of knowledge may turn on itself?" (23)

Near the close of his book, Jeans insists that

".....everything that has been said, and every conclusion that has been tentatively put forward is quite frankly speculative and uncertain." (24)
"perhaps...science should leave off making pronouncements; the river of knowledge has too often turned back on itself." (25)

The Freeing of Religion from the Over-Lordship of Science

It has been said, "when the cat's away, the mice play." The weakening of the dogmatic authority of science must naturally have the effect of freeing religious thinkers from the restraint upon their thinking which science formerly exercised. One of the best examples of this tendency is found in the spiritual autobiography of D aniel Arthur McGregor, a distinguished Episcopalian theologian, and a believer in "Churchianity". Professor McGregor says:

".... We looked to the Christian Church. It had had the power in the past to create the type of character in the individual and in society which our day needed. But it could only create this character if there were utter faith in the teachings of Christianity. We needed this character, the Christian Church could create it if we would believe, but we could not believe.

"And then came a breach in the stone wall of deterministic science. Poincaré pointed out the relative nature of the classical mathematics, and soon Einstein appeared with his new doctrine making relativity regnant in all fields of thought. The autocratic right of physical science was denied by these men who knew most about it.

"The new teaching did not establish the truth of religion but it put the whole question of faith in a new setting. The old foundations were not reconstituted but the character of some of the

objections had changed. We could not base our beliefs on an absolutely authoritative book, nor on the necessities of reason, but we were free to adopt such beliefs as we chose in the form of hypotheses and to uphold them as the truest truths if they proved the most valuable hypotheses for life. Science became the servant of man's life and justified its hypotheses by the service rendered. Religion might do the same if it would accept the same pragmatic criticism." (26)

McGregor continues:

"If the moral and social values vouchsafed by religion are the highest values in life, then we have a perfect right to demand that conflicting hypotheses found in other disciplines of thought should recognize the rights of the religious life. The day of dogmatism in science is past." (27)

In this regard, it might be remembered that Cardinal Newman also built his High-Churchism upon a foundation of total scepticism.

The Need for Humility in Theology

Without denying in any way the values of the pragmatic basis for religion, which McGregor and others have been able to build, now that science is less dogmatic; and while being glad

to see scientists limit their generalizations to the realms in which they arise, without trying to extend them into realms in which they do not apply, yet one can see that there is another conclusion warranted by the weakening of the authority of the conclusions of the exact sciences, and that is this: If the scientist dealing in the comparatively simple realms of the exact sciences, finds that he must be humble and non-dogmatic because the truths that he discovers are relative, and his theories subject to change, what warrant can there be for dogmatism among those who are studying the facts of the infinitely more complex realm of personality, and of the spiritual life. If the scientist is humble, how much more humble should be the theologian, dealing as he does in a relam so much more mysterious? If the conclusions of the scientist are tentative, how much more tentative should be the conclusions of the theologian who is studying subjects that are so

much more complicated? "The day of dogmatism in science is past." The day of dogmatism in religion should be past.

Chapter II

The Symbolic Nature of Science

Mathematical Symbols

In his "Meaning and Truth of Religion", Eugene Willian Lyman holds that:

"Perhaps the most important consequence of the theory of relativity for our cosmology is that it extends the sway of mathematics in physics further than ever before, and that by so doing it transforms the conceptions which formerly were ultimate for physics into mathematical symbols." (1)

He quotes E ddington to the effect that:

"The whole subject matter of exact science consists of pointer readings and similar indications..... The essential point is that, although we seem to have very definite conceptions of objects in the external world, those conceptions do not enter into exact science and are not in any way confirmed by it. Before exact science can begin to handle the problem they must be replaced by quantities representing the results of physical measurement." (2)

Lyman continues:

"The more then, that mathematics triumphs in physics, through the relativity theory, the more it renders the world as described by physics a

world of symbols. This means that the mechanistic view of the universe is displaced. 'We have travelled far', says Eddington, 'from the old standpoint which demands mechanical models for everything in Nature, seeing that we do not now admit even a definite unique distance between two points'. ... ... The theory of Relativity thus breaks with the mechanistic view of the world by reducing to a system of mathematical symbols the conceptions on which that view was based." (3)

Pointer Readings

Eddington agrees perfectly with Lyman, or perhaps we should say vice versa, as Lyman has probably derived his views from those of Eddington. In his "The Nature of the Physical World", Eddington draws four major philosophical conclusions, the first of which is:

"(1) The symbolic nature of the entities of physics is generally recognized; and the scheme of physics is now formulated in such a way as to make it almost self-evident that it is a partial aspect of something wider." (4)

Eddington says that:

"There is always the triple correspondence --

(a) a mental image, which is in our minds and not in the external world;
(b) some kind of counterpart in the external world, which is of inscrutable nature;
(c) a set of pointer readings, which exact science can study and connect with other pointer readings. " (5)

He illustrates the last point by considering an elephant sliding down a grassy bank. For a scientific treatment of this problem, one can forget both the elephant and the grassy bank. All that is necessary is one pointer reading, the weight of the elephant, and two other pointer readings, one of the degree of declivity of the bank, and the other a coefficient of friction.

He continues:

"The modern scientific theories have broken away from the common standpoint which identifies the real with the concrete". (6)

and exclaims:

"What we make of the world must be largely dependent on the sense organs that we happen to possess. How the world must have changed since man came to rely on his eyes rather than on his nose!" (7)

As a result of his recognition that he only knows these pointer readings and not ultimate material realities:

"The physicist now regards his own external world in a way which I can only describe as more mystical, though not less exact and practical,

than that which prevailed some years ago, when it was taken for granted that nothing could be true unless an engineer could make a model of it." (8)

Electron-Waves as the Symbols of our Knowledge of Probabilities

Sir James Jeans agrees with Eddington and Lyman as to the symbolic nature of science. He points out that:

"Heisenberg and Bohr have suggested that electron-waves must be regarded merely as a sort of symbolic representation of our knowledge as to the probable state and position of an electron."

They are either

".... mere visualizations of a mathematical formula of an undulatory, but wholly abstract nature;" or it must be held that the ".... minutest phenomena of nature do not admit of representation in the space time framework at all." (9)

The Parable of the Cave

Jeans prefaces his "The Mysterious Universe"

with Plato's "Parable of the Cave", and it is obvious that the underlying ideas of the Parable are very helpful to him in understanding the world of modern science.

"Just as the shadows on a wall form the projection of a three-dimensional reality into two dimensions, so the phenomena of the space-time continuum are four-dimensional projections of realities which occupy more than four dimensions so that events in time and space become 'no other than a moving row of Magic Shadow-shapes that come and go' ". (10)

"Most scientists would agree that they are nothing more than pictures - fictions if you like, if by fictions you mean that science is not yet in contact with ultimate reality. Many would hold that, from the broad philosophical standpoint, the outstanding achievement of twentieth-century physics is not the theory of relativity with its welding together of space and time, or the theory of quanta with its present apparent negation of the laws of the atom with the resultant discovery that things are not what they seem; it is the general recognition that we are not yet in contact with ultimate reality. To speak in terms of Plato's well-known simile, we are still imprisoned in our cave, with our backs to the light, and can only watch the shadows on the wall. At present the only task immediately before science is to study these shadows, to classify them, and explain them in the simplest possible way." (11)

The Making of Graven Images

Speaking from the viewpoint of science, Jeans goes on to say that:

"..... the final truth about a phenomena resides in the mathematical description of it; so long as there is no imperfedtion in this, our knowledge of the phenomena is complete." However, "a mathematical formula can never tell us what a thing is, but only how it behaves; ....

"The making of models or pictures to explain mathematical formulae and phenomena they describe, is not a step towards, but a step away from reality; it is like making graven images of a spirit. And it is as unreasonable to expect these various models to be consistent with one another as it would be to expect all the statues of Hermes .... to look alike.

"..... If he is to rely on statues, nothing less than a whole row, all different will suffice. All the same, the mathematical physicist is still busily at work making graven images of the concepts of the wave-mechanics.

"In brief, a mathematical formula can never tell us what a thing is, but only how it behaves; it can only specify an object through its properties. And these are unlikely to coincide in toto with the properties of any single microscopic object of our everyday life." (12)

Speaking of light in particular, he then goes on to say that we "know all there is to be known" about it, when we obtain "a mathematical formula which accurately describes its behavior." (13)

The Symbolic Nature of Theology

The direct bearing of all this upon Christian faith is plain. As Dr. Buckham says:

> "The spiritual world, by reason of its very nature and relationships, can find adequate expression only in parable, metaphor, symbol--something that is, which appeals to the imagination." (14)

The forgetting that religious truth is symbolic has done untold harm. The fact that it has been discovered that science also is symbolic will heop people to rightly understand the nature of religious beliefs. No person who was thoroughly imbued with the spirit of modern science could ever imagine that literal "saints" ever literally "washed" their literal "robes" and literally "made them cleaN" in the literal "blood" of a literal "lamb", but religionists of the past have been able to take every part of that famous figure of speech literally, except the last, and perhaps, there has also been a doctrine of the "lamb-hood" of Christ, of which I have not heard.

Not only the non-philosophical, but professional theologians themselves will undoubtedly reap great advantages from a clever understanding of the symbolic nature of our knowledge. Old doctrines like that of the Trinity may have arisen historically in a kind of realistic-idealism of the past, but they can only live and be vital today as the symbols of great truths. Rawlinson somewhere makes the remark that he has never seen a metaphysical explanation of the Incarnation that suited him, but that the Christian myth that God in Christ came down from Heaven and gave himself for us contains great religious truth.

However, the clearer understanding of the symbolic nature of theology will have other beneficial effects. For instance, literal facts can be in contradiction, but wo symbolic representations of the same reality may be literally incompatible and yet both be true.

Again symbols are valuable for practical purposes and there can be no necessity for anyoneto use some particular symbol, if some other is for any reason

better for him. Some symbols are more adequate, or better on the average, but basicly there is no reason why Martin Luther, whose father had beaten him until he always shuddered to hear God spoken of as "Father", should not have conceived God as "Mother", even though that symbol is, on the average, less adequate, and more subject to misunderstanding, than is the one of "Fatherhood".

Again those of us who find great value in symbols of religious truth, when we clearly understand that they are symbols, will not hold it against those literal minded persons, who will not use symbols, but persist in describing religious realities by the way in which they act upon us. God is the source of the "social-bond" and the source of the "integrating process", and the only necessary meaning that we need to see in a refusal to go beyond these "behavior-concepts" of God, is that those who refuse to go beyond them are literal-minded philosophers, who do not understand

the uses and values of symbols.

The break-down of mechanism also is all to the good from a religious point of view, but we will deal with this again in a later chapter.

Conclusion

Thus we find a consensus among modern scientists that science is not yet in contact with ultimate reality, and that its truths are symbolic, and we have found that a clearer understanding of the symbolic nature of all knowledge will have very healthy influences upon religion and theology, because the concepts of theology are and must necessarily be also symbolic.

Chapter III

The Quantum Theory and the Principle of Causality

Errors in Measuring the Position and Speed of Protons

When physicists had finally been able to break up the atom into nuclei, (consisting of protons and electrons) and electrons, certain peculiarities in the behavior of protons and electrons began to attract attention. For instance, it was discovered that it was very difficult, or rather, impossible to obtain the exact position of a proton at an exact time. Jeans in speaking of our knowledge of the interior of the atom, says:

> "Thus we are confronted with the dilemma that one kind of protons are so energetic that they give the universe a violent kick before leaving it, and so give us inexact information about its present condition, while the other kind are so slow in telling their story when they arrive that they cannot give us exact information in respect of time. Intermediate kinds fail in both respects."

"Exact mathematical discussion shows that, as we try one kind of proton after another, the product of the two errors can never fall below a certain minimum value. If the experiments are designed and performed with perfect skill, the product of the two errors is the same for all kinds of protons, and is equal to" (a certain) "minimum value." (1)

This "minimum value" was equal to Planck's "h", of the Quantum Theory.

The Quantum Theory

"Stated in general terms the quantum theory stands for the experimentally established fact, first discovered by Planck in 1900, that the radiation of light or any other form of energy is not continuous, as the accepted wave theory required it to be, but is discontinuous and is accomplished through the emission by the energy-source of an infinite number of infinitesimal units or "bullets" of radiation". (2)

The value of this basic unit of radiation could be jeasured, and is represented by the symbol "h", referred to above.

Heisenberg's Principle of Indeterminacy

It was Heisenberg that showed that the peculiarities of these sub-atomic entities and of the quantum theory could not be described in terms of space and time, without invoking a principle of uncertainty. This is Heisenberg's Principle of Indeterminacy. It will be shown later that another explanation is possible.

Heisenberg's Principle of Indeterminacy opened up the whole question of Causation to debate, together with such theological ideas as the "freedom of the will", and on no question in the exact sciences is there a greater difference of opinion than on that of Causation, and thus we had best give the views of various thinkers, before attempting to draw any conclusions of our own.

Lyman on Causation

We will begin with the theologian Lyman . He holds that as a result of the Quantum Theory, and of these peculiarities in the behavior of sub-atomic entities, expecially their indeterminism, there may

> "First .... be set down the conception that classical laws of physics are to be regarded as statistical averages rather than as the final account of the nature of things." (3)

To sustain this position he quotes from certain philosophers of science as follows:

> "Thus Bertrand Russell says: 'The course of nature is not so definitely determined by the physical laws at present known as it was formerly thought to be. We cannot predict when a discontinuous change will take place in a given atom, though we can predict statistical averages'. (4) Likewise Whitehead writes: 'The characteristic laws of inorganic matter are mainly the statistical averages resulting from confused aggregates'". (5)

Lyman continues

> "A particle may have position or it may have velocity but it cannot in any exact sense have both." (7)

Lyman on the Religious Consequences of Indeterminacy

Lyman then goes on to show the important religious consequences of this breakdown of causation.

> "It has been, in truth, the conception of a completely determined physical universe, of which man in his bodily life was an integral part, which has brought confusion into our thought of man's moral and religious life. This conception has meant that consciousness was non-efficacious, and consequently that the aims and values which we cherish in our conscious life are futile. But now this conception turns out to be, not the well-founded implication of the world of science, but a dogma which has imposed itself upon our imagination." (8)

Reichenbach on Causality

In "Atom and Cosmos", Hans Reichenbach has a full discussion of the problem of Causality and of Probability. He says:

> "The interpretation of quantum mechanics, as we have seen, arrives at a renunciation of the strict concept of law with which physics has previously operated in all its theories. The fundamental principle that law rules universally is also called the principle of causality; and now that quantum mechanics uses, in its place, the concept of a connection between events that is ruled merely by probability, it is the problem of causality

and probability which must concern us." (9)

After pointing out that the concept of causality has been under fire at various times, and from various directions (more Freedom of the Will) in the past, he continues:

"It is only now, therefore, that we have to speak of a real crisis for the causal concept, when doubts as to the perfect determination of all natural happenings gain ground even in physics, and when, as we have shown these doubts, precisely in the mechanics of the interior of the atom, have led to conscious renunciation of causal concepts." (10)

"Thus the idea of probability unavoidable enters the formulation of all laws of nature, if these laws are to be stated with complete conceptual rigour.

"In daily life, too, the concept of probability finds much more far-reaching application than is generally believed. We fail to notice that it is umplied in many statements, because the probability involved is very high and so can be treated practically as if it were absolute certainty." (11)

"Nature is simply not completely determined. It is not to be compared to the precise functioning of a machine, for chance ruled in small dimensions, and it is only in the large that the numberless separate atomic events combine in processes of such great probability that we can treat them in practice as certain." (12)

"It is of crucial importance that the solid barrier which determinism erects against every non-deterministic solution of the problem of life and freedom has fallen, that we can no longer speak of objective predeterminations of the future, and that the concept of possibility and of becoming takes on an entirely new aspect when we no longer need regard it as an illusion due to human ignorance, as a mere substitute for the description of real and objectively existing facts, which are only subsequently withheld from human beings." (13)

Millikan on Determinism

For Robert Andrews Millikan, the "freedom of the human will" is one of those "brute facts", that he likes to talk about. As to philosophic and scientific determinism, he says:

"To me philosophic determinism is a pure dogma of no particular interest to the man who has even scented afar the scientific method. Scientific determinism, as we use it in physics, is merely a convenient working hypothesis, certainly no more difficult to reconcile with free will than are the wave properties of electrons and protons difficult to reconcile with their corpuscular properties." (14)

Russell on Causality

Bertrand Russell also falls in line on causality:

> " 'Great principles', such as the 'uniformity of Nature', the 'law of universal causation', and so on, are attempts to bolster up our belief that what has often happened before will happen again, which is no better founded than the horse's belief that you will take the turning you usually take. It is not altogether easy to see what is to replace these pseudo-principles in the practice of science; but perhaps the theory of relativity gives us a glimpse of the kind of thing we may expect. Causation in the old sense, no longer has a place in theoretical physics. There is, of course, something else which takes its place, but the substitute appears to have a better empirical foundation than the old principle which it has superseded." (15)

Planck Dissents

With so many scientists agreein that Planck's discovery of the quantum theory thus necessitates the giving up of the strict concept of causation, one might expect Planck himself to have given it up most completely, but such is not the case.

He says:

> "Today, indeed, there are eminent physicists who under the compulsion of facts are inclined to sacrifice the principle of strict causality in the physical view of the world.
>
> "If such a step should actually prove necessary

the goal of physicists would become more remote and this would be a disadvantage whose importance it is impossible to over-estimate. For in my opinion, so long as any choice remains, determinism is in all circumstances preferable to indeterminism, simply because a definite answer to a question is always preferable to an indefinite one.

"So far as I can see, however, there is no ground for such a renunciation. For there always remains the possibility that the reason why it is impossible to give a definite answer resides, not in the nature of the theory, but in the manner in which the question is asked." (16)

In the same volume, he returns later to this subject, saying:

"In my opinion, therefore, it is essential for the healthy development of physics that among the postulates of this science we reckon, not merely the existence of law in general, but also the strictly causal character of this law. This has in fact almost universally been the case. Further, I consider it necessary to hold that the goal of investigaion has not been reached until each instance of a statistical law has been analyzed into one or more dynamic laws. I do not deny that the study of statistical laws is of great practical importance: Physics, no less than meteorology, geography, and social science, is frequently compelled to make use of statistical laws. At the same time, however, no one will doubt that the alleged accidental variations of the climatological curves, of population statistics and mortality tables, are in each instance subject to strict causality; similarly physicists will always admit that such questions are strictly relevant as that which asks why one of two neighboring atoms of uranium

exploded many millions of years before the other.

"All studies dealing with the behavior of the human mind are equally compelled to assum the existence of strict causality." (17)

Planck denies that determinism and the freedom of the will are in conflict.

"If a man were able to forecast his own future solely on the ground of causality, then and then only we would have to deny this consciousness of freedom of the will." (18)

In his "Where is Science Going", Planck also discusses this problem very fully, and it is apparent that he and Einstein agree.

Eddington on Causality

There is a passage in Eddington's "Nature of the Physical World", which could almost have been written as a criticism of Planck's point of view. He says:

"It is difficult to see now any justification for the strongly rooted conviction in the ultimate reestablishment of a deterministic scheme of law, except a supposed necessity of thought. Thought has grown accustomed to doing without a great many "necessities" in recent years." (19)

"The future is a combination of the causal

influences of the past together with unpredictable elements-- unpredictable not merely because it is impracticable to obtain the data of prediction, but because no data connected causally with our experience exist." (20)

"Those who maintain a deterministic theory of mental activity must do so as the outcome of their study of the mind itself and not with the idea that they are thereby making it more conformable with our experimental knowledge of the laws of inorganic matter." (21)

Eddington does not agree with Planck that determinism and the freedom of the will are not incompatible, or at least, he has a different conception of the freedom of the will. He holds that:

"A complete determinism of the material universe cannot be divorced from determinism of the mind.... There can be no fully deterministic control of inorganic phenomena unless the determinism governs mind itself. Conversely, if we wish to emancipate mind, we must to some extent emancipate the material world also. There appears to be no longer any obstacle to this emancipation." (22)

Eddington lists the abandonment of strict causality as the second of his four major philosophic results of the new physics:

" (2) Strict causality is abandoned in the material world. Our ideas of the controlling laws are in process of reconstruction and it is not possible to predict what kind of form they will ultimately take; but all the indications are that

strict causality has dropped out permanently. This releases the former necessity of supposing that mind is subject to deterministic law or alternately that it can suspend deterministic law in the material world." (23)

Later in his treatment of the spiritual side of life, Eddington goes on to say:

"In so far as supernaturalism is associated with the denial of strict causality ... I can only answer that that is what the modern scientific development of the quantum theory brings us to." (24)

Jeans Suggests Another Possibility

It would appear as if Planck's dissent would have to be overruled if Jeans did not come to his rescue with the idea that the

"... apparent undeterminacy of nature may arise merely from our trying to force happenings which occur in many dimensions into a smaller number of dimensions." (25)

He points out that "Heisenberg attacked the enigma of the physical universe by giving up the main enigma-- the nature of the objective universe-- as insoluble and concentrating on the minor puzzle of co-ordinating our observation of the universe. Thus it is not surprising that the wave picture which finally emerged should prove to be concerned solely with our knowledge of the universe as obtained through our senses." (26)

He goes on to point out that Heisenberg himself has

"exhibited the contrast between the present view and the old in the following scheme:

Classical Theory:
Causal relationships of phenomena described in terms of space and time.

Quantum Theory:
Either: Phenomena described in terms of space and time (but uncertainty principle)
Or: Causal relationship expressed by mathematical laws (but physical description of phenomena in space and time impossible)" (27)

Whereas Heisenberg chose the first alterna-tive and the principle of indeterminacy, Jeans feels that the second alternative is the more promising. Taking it, he points out that:

"The fact that the surface phenomena of space-time show a want of determinism leaves the question of whether real objective nature is deterministic or not completely open.

"Space-time is not the framework of the world of nature, but of the world of our sense-perceptions, and when we represent objects beyond our senses in space-time, their apparent absence of determinism may be merely the price we pay for trying to force the real world of of nature into too cramped a framework. So,

when birds fly through the air, their shadows on the ground beneath obey no uniform or deterministic laws, even though the actual flights of the birds may do so." (28)

He quotes Planck to the effect:

"Some essential modification seems to be inevitable; but I firmly believe in company with most physicists, that the quantum hypothesis will eventually find its exact expression in certain equations which will be a more exact formulation of the law of causality." (29)

The Freedom of the Will

Where the authorities disagree so utterly as they do on this matter, any conclusions must needs be very tentative. However it might appear that on the one hand, Eddington is right when he affirms that

"Those who maintain a deterministic theory of mental activity must do so as the outcome of their study of the mind itself and not with the idea that they are thereby making it more conformable with our experimental knowledge of the laws of inorganic matter." (30)

and on the other hand that Horton is right when he

says of the Principle of Indeterminacy that it is

"... premature to jump from it to an affirmation of free-will in the human sphere.... This principle seems not to have proved that electrons behave erratically, but only that our ability to observe their behavior has absolute limits." (31)

The God of Law

Nor is it certain that religion has anything to gain by the loss of the principle of causality. It is very possible that Planck is right, and that determinism, and the freedom of the will are not actually in conflict.

Also since the days of Amos, God has been thought of as a God of law, or Mishpat, and to lose God in a thoroughly disorganized world would be a very heavy price for religion to pay for a greater ease in conceiving of the freedom of the will.

Also it is probable that the new conceptions of time which may develop from the new scientific discoveries may have a much more marked influence upon the whole problem of determinism, causation,

and the freedom of the will, in the long run than will the Principle of Indeterminism.

The Idea of Probability in Religion

If a substitution is actually made of the conception of probability and of statistical law for that of causal law, it is probable that religion will find it possible to make good use of the idea of probability. (As a matter of fact, it might be used even if no such substitution did take place.) Thus in a world in which parthogenesis has actually been known to take place among lower forms of life, to say that the Virgin Birth is impossible is to be unduly dogmatic, but when it is brought out into the realm of probability, the probability that anything of the sort ever did take place is very small indeed.

Conclusion

The conclusion of this chapter must be that the matters dealt with are still the subjects of controversy, and that until there is something more in the nature of a consensus, any conclusion must be very tentative, and any marked conclusion would be premature. It is interesting that the idea of causation is under fire. It is not certain that it is done for.

Chapter IV

Time Entropy and Events

In this chapter, we mean to deal with three problems which are touched upon but lightly, by those philosophers who are dealing with the philosophical implications of modern developments in science, but which may well be of the utmost importance to the philosophic thought of the future.

I

Time and Relativity

In the doctrine of relativity, time disappears as a separate and distinct kind of entity and becomes one dimension in a four dimensional continuum. Whether this four dimensional continuum is an actual entity in the world of reality, or

whether it is merely a framework into which our mind compresses realities which actually are many dimensional, as has been suggested by Jeans, is not certain.

Jean's Idea of Time

Jeans inclines to the view that the real world is multi-dimensional, and is compressed into the four dimensional continuum by our methods of knowing. In such a system, time must, like the other tools of science, be considered as symbolic in nature.

In the realm of phenomena

> "matter... moves through space at all kinds of different speeds, but all are small in comparison with the speed of light..... Matter moves in the direction of time." (1)

Thus objects in the space-time realm are commonly widely extended in one direction which is the direction of time.

Jeans says that when two single electrons melt, in order to understand the electrons, we must have "three dimensions of space for each electron, and one of time", which dimension of time is shared by both electrons. Thus

"... Time figures as the mortar which binds the bricks of matter together" or it may be that we should think of the "electrons as objects of thought and time as the process of thinking." (2)

The running of time and space together seems to make time in some way static; its seeming fluidity must be a result of the way in which we apprehend it. As Jeans says:

"In this case, our consciousness is like that of a fly caught in a dusting mop which is being drawn over the surface of the picture; the whole picture is there, but the fly can only experience the one instant of time with which it is in immediate contact, although it may remember a bit of the picture just behind it, and may even delude itself into imagining it is helping to paint those parts of the picture which lie in front of it..... At present science can tell us very little as to the way in which our consciousness apprehends the picture; it is concerned mainly with the nature of the picture." (3)

He continues:

"Modern scientific theory compels us to think of the Creator as working outside time and space, which are parts of his creation, just as the artist is outside his canvas." (4)

Time and Entropy

Eddington also wrestles with the problem of time. He feels that most realities in physics are of such a nature that it is possible to pass both ways in them. He asks the question as to whether this is true also of time. Can time run backwards as well as forward? He decides that direction in time is indicated by an increase of entropy and that time thus cannot run backward, because of the Second Law of Thermo-dynamics holds that Entropy must increase, and not decrease. The utter canctity of the Second Law is not only implied, but is directly expressed. He denies that there can be any "absolute now." Time is a relative term.

The Importance of Changes in Our Conception of Time

Bertrand Russell holds that:

"The collapse of the notion of one all-embracing

time, in which all events throughout the universe can be dated, must in the long run affect our views as to cause and effect, evolution, and many other matters. For instance, the question whether, on the whole, there is progress in the universe, may depend upon our choice of a measure of time. If we choose one out of a number of equally good clock, we may find that the universe is going from bad to worse as fast as the most melancholy Slav could imagine. Thus optimism and pessimism are neither true nor false, but depend upon the choice of clocks." (5)

It would appear as if Russell is right and that any large change in our conception of time must necessarily affect great changes in our philosophy, and in our ways of conceiving of religious truth. However what the changes will be, it is not yet possible to foresee.

II

Entropy and the Death of the Universe

It has been mentioned that Eddington believes that direction in time is indicated by the increase of Entropy. The Second Law of Thermo-dynamics holds that heat or energy tends to become evenly

distributed over the universe. Now when this process has finally worked itself out and the heat is actually evenly distributed, the universe will be dead.

Entropy and God

In a universe which is moving toward this even distribution of heat, or Entropy, and which has been doing so for millions of years, it is difficult to understand why it has not yet arrived at the state of Entropy; and also in a universe attached to such a law of death, how did life ever arise? Eddington feels that this problem implies a God who must have wound the machine up in the first place; it being steadily engaged in the process of running down at the present time.

Radio-Activity and Entropy

Millikan in dealing with some of the facts of

radio-activity, as they have been discovered in connection with radium and uranium, points out that:

"With radium and uranium we do not see anything but the decay. And yet somewhere, somehow, it is almost certain that these elements must be continually forming." (6)

Going to the problem of Entropy, he comments:

"It is impossible that the sun is simply a hot body cooling off, because we have evidence that it has lived longer than it could have if that were the case. The astronomer has now, however, seized upon the facts of radio-activity and surmizes that these sub-atomic energies may be the source of the sun's radiation. If so the supplies are not so limited as we thought." (7)

"Professor Joly has computed that if there are two parts of radio-active material for every million parts of other matter throughout the whole volume of the earth, and this is considerably less than he has found on the average in the earth's crust, then this earth, instead of cooling off, is actually now heating up; so that in a hundred million years the temperature of its core will have risen through 1800 degrees Centrigrade. That is a terperature which will melt almost all of our ordinary substances. What does it mean? It means that the life history of our planet is perhaps not at all what we have heretofore thought that it was. It means that a planet that seems to be dead, as this our earth seems to be, may, a few eons hence, be a luminous body, and that it may

go through periods of expansion when it radiates enormously and then of contraction when it becomes like our present earth, a body which is a heat insulator and holds in its interior the energy given off by radio-active processes until another period of luminosity ensues." (8)

Eddington also considers the possibility of c cycles in the history of the universe, but the idea does not appeal to him. It might be imagined that, because Millikan disagrees heartily with the scientific basis of Eddington's proof of God based upon Entropy, that perhaps Millikan would not agree with Eddington on the philosophic result, but this is not the case. Millikan believes in God also. Millikan believes that the universe is being affected by certain Cosmic Rays, whose source is unknown. They keep the world wound up, and could be considered God acting at present, in contradiction to Eddington's God, who is conceived as winding the machine up at some time in the past.

Radio-Activity and Progress

Millikan also believes that the fact that we actually know that one chemical element is being changed into other chemical elements, (i.e. radium into lead and helium) must strengthen our belief in the possibility of progress.

One conclusion that one could make from Millikan's discussion is that the increase of Entropy is not so sure and steady as some pessimistic people have felt it to be, and that the absolute proofs that optimism is a mistake may be omitting certain important, but less apparent factors. The increase of Entropy is not so certain as to absolutely rule out all possibility of progress.

III

Events

Both Bertrand Russell and Whitehead feel that the relativity physics have undermined the concept of substance, and that a concept of "events" must take its place. Russell says:

> "The world which the theory of relativity presents to our imagination is not so much a world of "things" in "motion" as a world of events. It is true that there are still electrons and protons which persist, but these... are really to be conceived as strings of connected events, like the successive notes of a song. It is events that are the stuff of relativity physics. Between two events which are not too remote from each other there is, in the general theory as in the special theory, a measurable relation called "interval", which appears to be the physical reality of which lapse of time and distance in space are two more or less confused representations. Between two distant events, there is not any one definite interval. But there is one way of moving from one event to another which makes the sum of all the little intervals alon g the route greater than by any other route, This route is called a "geodesic", and it is the route which a body will choose if left to itself.
>
> "The whole of relativity physics is a much more step-by-step matter than the physics and geometry of former days." (9)

Events, Mind, and Matter

It is to be noticed that Russell's opinion that the ultimate entities are events weakens the traditional distinction between mind and matter. Both are organizations of events. They differ because the events are organized into different types of structure, and in accordance with different plans, but the ultimate elements of both mind and matter are the same.

Events and Personality

Attempts have been made notably by Whitehead and by James to think of personality, not in terms of substance, but in terms of events or of a flow of consciousness. It cannot be said that the results of such attempts have been adequate as yet.

However, if it is found to be possible to adequately interpret personality also in less static terms, than has been done by many in the past such a change may help to solve some of our problems.

Chapter V

Mathematics and Mind-Stuff

I

The Mathematical Nature of Nature

Sir James Jeans points out that

" all the pictures which science now draws of nature, and which alone seem capable of according with observational fact, are mathematical pictures." As Galileo said "nature's great book is written in mathematical language." (1)

If we were in the cave of Plato's parable,

and saw the shadows of a group of chess players

on the walls of our cave, we should

"recognize the chess players out in the sunlight as being governed by minds like our own; we should find the counterpart of our own thoughts in the reality which was forever inaccessible to our direct observation." Similarly "nature seems very conversant with the rules of pure mathematics, as our mathematicians have formulated them in their studies, out of their own inner consciousness, and without drawing to any appreciable extent to this experience of the outer world." (2)

Criticism:-Moulding Nature to Our Minds

It might be criticized that in claiming that nature is mathematical, we are "moulding nature to our preconceived ideas", but upon such a basis, how could one explain the failure of the anthropomorphic and mechanical interpretations of nature? (3)

"In some way nature is more closely allied to the concepts of pure mathematics than to those of biology or engineering, and even if the mathematical interpretation is only a third man-made mould, it at least fits nature incomparably better than the two previously tried. (4)

"The universe appears to have been designed by a pure mathematician." (5)

Criticism:- Mathematics Derived from Nature

Again it might be criticized that:

"There is no absolutely sharp line of demarcation between pure and applied mathematics.

"Pure mathematics... does not in actual fact represent a creation of our own minds so much as an effort, based on forgotten or subconscious memories, to understand the workings of nature. If so, it is not surprizing that nature should be found to work according to the laws of pure mathematics." (6)

This does not seem to be true of pure mathematics, and further more, it is

"... nature and our conscious mathematical minds" (which) "work according to the same laws. She does not model her behavior, so to speak, on that forced on us by our whims and passions, or on that of our muscles and joints, but on that of our thinking minds. This remains true whether our minds impress their laws on nature, or she impresses her laws on us, and provides a sufficient justification for thinking of the designer of the universe as a mathematician." (7)

Nature as Thought

Thus it would appear as if the structures of nature are

"... structures of pure thought, incapable of realization in any sense which would properly be described as material.... The universe can be best pictured, although very imperfectly and inadequately, as consisting of pure thought, the thought of what ,for want of a wider word, we must describe as a mathematical thinker." (8)

Jeans quotes from Berkeley:

"All the choir of heaven and furniture of earth, in a word all those bodies which compose the mighty frame of the world, have not any substance without the mind.... So long as they are not actually perceived by me, or do not exist in my mind, or that of any other created spirit, they must either have no existence at all, or

else subsist in the mind of some Eternal Spirit." (9)

Jeans comments that science by a very different route seems to have come to a not dissimilar conclusion.

Natural Law as Laws of Thought

Jeans then goes on to say:

"Again we may think of the laws to which phenomena conform in our working hours, the laws of nature, as the laws of thought of a universal mind. The u uniformity of nature proclaims the self-consistency of this mind.

"This concept of the universe as a world of pure thought throws a new light on many of the situations we have encountered in our survey of modern physics." (10)

The Primacy of Mind

Jeans continues:

"If the universe is a universe of thought, then its creation must have been an act of thought." (11)

And also

"Today there is a wide measure of agreement, which on the physical side of science approaches almost to unanimity, that the stream of knowledge is heading towards a non-mechanical reality;

the universe begins to look more like a great thought than like a great machine. Mind no longer appears as an accidental intruder into the realm of matter; we are beginning to suspect that we ought rather to hail it as the creator and governor of the realm of matter, not of course our individual minds, but the mind in which the atoms out of which of individual minds have grown exist as thoughts.

"The new knowledge compels us to revise our hasty first impressions that we had stumbled into a universe which either did not concern itself with life or was actively hostile to life. The old dualism of mind and matter, which was mainly responsible for the supposed hostility, seems likely to disappear not through matter becoming in any way more shadowy or insubstantial than here-to-fore, or through mind becoming resolved into a function of the working of matter, but through substantial matter resolving itself into a creation and manifestation of mind. We discover that the universe shows evidence of a designing or controlling power that has something in common with our own individual minds-- not, so fas as we have discovered, emotion, morality, or aesthetic appreciation, but the tendency to think in a way which, for want of a better word, we describe as mathematical." (12)

Joad has criticized Jeans as holding at the same time two different conceptions, one of the universe as obviously the creation of One who thinks in mathematical terms. It would appear as if this criticism was just from a logical point of view, as Jeans does express himself in both ways.

From a practical point of view, the two views are very similar in that both emphasize the primacy of mind.

II

Bertrand Russell Concurs

Jeans quotes Bertrand Russell to the effect:

"The events that happen in our minds are part of the course of nature, and we do not know that the events which happen elsewhere are of a totally different kind.... The world presented for our belief by a philosophy based upon modern science is in many ways less alien to ourselves than the world of matter as conceived in former centuries." (13)

In his "A.B.C. of Relativity", Russell also comments that

"what we know about the physical world... is much more abstract then was formerly supposed." (14)

III

Mind-Stuff

Eddington also agrees with Jeans that

"... the stuff of the world is mind-stuff". (15)

He adds that

"The only subject presented to me for study is the contents of my own consciousness." (16)

"Presumably human nature has been specialized to a considerable extent by the operation of natural selection; and it might well be debated whether its valuation of permanence and other traits now apparently fundamental are essential properties of consciousness or have been evolved through inter-play with the external world. In that case the values given by mind to the external world have originally come to it from the external world-stuff. Such a tossing to and fro of values is, I think, not foreign to our view that the world-stuff behind the pointer readings is of nature continuous with the mind." (17)

The fundamental importance of consciousness is the third of Eddington's four major philosophical conclusions from the findings of the modern exact sciences.

" (3) Recognizing that the physical world is entirely abstract and without 'actuality' apart from its linkage to consciousness, we restore consciousness to the fundamental position instead of representing it as an inessential complication occasionally found in the midst of inorganic nature at a late stage of evlutionary history." (18)

The Universal Mind

"The idea of a universal Mind or Logos would be, I think, a fairly plausible inference from the present state of scientific theory; at least, it is in harmony with it. But if so, all that our inquiry justifies us in asserting is a purely colorless pantheism. Science cannot tell whether the world-spirit is good or evil, and its halting argument for the existence of a God might equally well be turned into an argument for the existence of a Devil." (19)

The New Theism

Lyman goes beyond the Panpsychism of Jeans and Eddington to the assertion of the existence of God. He says:

"The new cosmology gives powerful intellectual support to belief in God. For it portrays to us a universe which has order, and imagination, and organic character on such a scale as can be understood only by recognizing a Cosmic Creative Spirit everywhere at work. Mechanism no longer suffices to explain the physical order." (20)

"But", he goes on to say, "the theism which may hope to complete the new cosmology will be in many respects a new theism. It will be a theism which will include the fact that, although mechanism is not the ultimate truth for science, and still less for philosophy it has its relative truth." (21)

Conclusion

The discovery of the large part which mathematics has in the structure of the universe is one of the most interesting developments of modern science, and would seem logically to lead, as Jeans, Eddington, and Lyman have inplied to a greater emphasis upon the importance of mind, and to the teleological argument for the existence of God.

The tendency to resolve the traditionally sharp antithesis between mind and matter may also lead to important religious results.

It may especially emphasize the fact that in human beings the physical and the spiritual are so thoroughly intertwined that any attempt to deal with the one while ignoring the other is thoroughly abstract and out of keeping with the realities of the situation. The Salvation Army, and other groups which have been able to achieve wonderful results,

have always kept this truth before their eyes, and it is to be hoped that the rest of us will find our hands strengthened when we are forced to stop treating human spirits as if they existdd in a vacuum. On the other hand, the forces of crass materialism may well come to see that man is more than a machine or an animal. The break-down of the sharp distinction between the physical and the mental or spiritual is all to the good from the religious point of view.

Chapter VI

'cience Religion and Mysticism

I

Building the Spiritual World

Eddington especially among the scientists passes from scientific beliefs to religious beliefs. He says:

> 'All I would claim is that those who in the search for truth start from consciousness as a seat of self-knowledge with interests and responsibilities not confined to the mathematical plane, are just as much facing the hard facts of experience as those who from consciousness as a device for reading the indications of spectroscopes and minometers." (1)

He includes "the sanction for correlating a spiritual domain to another side of our personality" as the fourth of his four principle philosophical conclusions from the modern developments in the exact sciences.

" (4) The sanction for correlating a "real" physical world to certain feelings of which we are conscious does not seem to differ in any essential respect from the sanction for correlating the spiritual domain to another side of our personality." (2)

He repudiates "the idea of proving the distinctive beliefs of religion either from the data of physical science, or by the methods of physical science." (3)

But he holds that:

"We have to build the spiritual world out of the symbols taken from our own personality, as we build the scientific world out of the metrical symbols of the mathematician." (4)

The Need for a Sense of Proportion

Eddington feels that much of the opposition to religion arises out of the lack of a sense of proportion and of fitness. He says:

"The materialist who is convinced that all phenomena arise from electrons and quanta and the like controlled by mathematical formulae, must presumably hold the belief that his wife is a rather elaborate differential equation, but he is probably tactful enough not to obtrude this opinion in domestic life. If this kind of scientific dissection is felt to be inadequate and irrelevant in ordinary personal relationships,

It is surely out of place in the most personal relationship of all - that of the human soul to a divine spirit.

"We are anxious for perfect truth, but it is hard to say in what form perfect truth is to be found. I cannot quite believe that it has the form typified by an inventory. Somehow as part of its perfection there should be incorporated in it that which we esteem as a "sense of proportion". The physicist is not conscious of any disloyalty to truth on occasions when his sense of proportion tells him to regard a plank as a continuous material, well knowing that it is "really" empty space containing sparsely scattered electric charges. And the deepest philosophical researches as to the nature of the Deity may give a conception equally out of proportion for daily life; so that we should rather employ a conception that was unfolded nearly two thousand years ago." (5)

Higher Realities

Planck also feels that:

"modern Physics impresses us particularly with the truth of the old doctrine which teaches that there are realities existing apart from our sense-perceptions, and that there are problems and conflicts where these realities are of greater value for us than the richest treasures of the world of experience." (6)

II

Criticism

In his "Philosophical Aspects of Modern Science", Joad criticizes the views of Eddington, of Jeans, and of Russell at length. He feels that

> "when the scientist leaves his laboratory and speculates about the universe as a whole, the resultant conclusions are apt to tell us more about the scientist than about the universe." (7)

He feels that

> "the temper of mind from which these metaphysical speculations spring, and in which they are conducted, is fundamentally unscientific.
>
> "It lays itself open to the charge of arriving at conclusions which are merely a rationalization of the wishes of its authors, and it derogates from the dignity of the universe by assimilating it to the human spirit." (8)

Mysticism

Although Joad criticizes mysticism, when used to get to the "reality" of the world of phenomena, all phenomena being believed to be misleading, yet he believes that the mystical experience is a real experience in which the mystic comes in contact with some higher realm of being, including such things as "value", and "the aesthetic". He writes:

> "It is as though in the case of the mystic an envelope, which shuts most of us off from the world of reality, were torn or frayed, so the mystics consciousness filters through into a region which is normally inaccessible." (9)

> "If I am right in my suggestion that mystical experience is the awareness of a new order of reality, then the essence of it is incommunicable." ...
>
> "It follows that there is no need to suppose either that the familiar world is unreal, or that the mystical experience implies self-transcendence, merely because mystics have supposed that only on the basis of these beliefs could full justice be done to the uniqueness of that experience." (10)

Joad seems to think that many of the New Physicists are attempting to use mysticism to get to the reality of things. This criticism does not seem to be warranted. In France, Bergson and others basing their conclusions on the evidence of biology, and on a careful study of human consciousness have tended to emphasize the umportance of intuition, but the point of view of the physicists does not seem to be unduly mystical. However it must be said that in all science, it is commonly by an intuition that the scientist first sees his hew hypothesis, and then he proceeds to test it by careful empirical tests.

Conclusion

It would appear as if in the realm of the New Physics, it is justifiable to "correlate a spiritual world to another side of our personality",

as Eddington avers, and yet it is also true, as both Eddington and Joad insist, that this new realm is not proven by science. Science merely makes room for it if it is implied by the other facts of experience.

It does not appear that Joad's idea of the nature of mysticism is based on the findings of the New Physics. However, if this conception of a higher realm were true, it is possible that such realities as the social bond, values, and the objects of religious experience belong to this realm.

It would appear that the new findings would indicate as Jeans claims that we are not yet in contact with ultimate reality, and that the correct inference from such a fact would be the need for a certain humility in the presence of the deep mysteriousness of nature, and a willingness to search out the empirical facts of the phenomenal world. It would not necessarily

imply any the possibility of getting to the world of reality by mystical means. On the other hand mysticism must not be ruled out. Like every other tub it must stand on its own bottom.

Chapter VII

Philosophical Systems as Influenced by the New Physics

I

Pragmatism

One of the first results of the breakdown of the old systems of though was an emphasis upon that which was necessary for practical purposes. Thus Dean Weigle of Yale relates his contribution to "Contemporary American Theology", how discussions of the "philosophical implications of the non-Euclidian geometries", prepared his mind for the reading of William James's "The Will to Believe".

Also as we saw earlier, the new discoveries helped McGregor to base his "Churchianity" upon a pragmatic basis.

Eddington also speaks of this tendency;

"The 'success' theory naturally justifies

itself to the physicist. He employs this type of activity of the brain because it leads him to what he wants - a verifiable prediction as to the external world - and, for that reason he esteems it. Why should not the theologian employ and esteem one of the mental processes of unreason which leads to what he wants - an assurance of future bliss, or a Hell to frighten us into better behavior? Understand I do not encourage theologians to despise reason; my point is that they might well do so if it had no better justification than the success theory." (1)

Eddington here lays his finger upon the weakness of an unduly crude pragmatism. It brings in any result that we want. The over-emphasis upon pragmatism was merely an aspect of a period of transition, and it has already passed.

The Scientific Method

The nature of some aspects of the scientific method itself might be suposed to imply a certain type of philosophical system rather than another. One of the most important aspects of the scientific method is its empiricism. As Julian Huxley says:

"Science insists on continual verification by testing aganinst facts, because the bitter experience of history is that without such constant testing, man's imagination and logical faculty run away with him and in the long run make a fool of him." (2)

Millikan especially emphasizes the empirical side of the scientific method. He says:

"The method consisted in discarding all a priori postulates about the nature of reality and all complete philosophic schemes, such as all the philosophers of the ancient world, idealists and atomists alike, had started with, and quarrelled interminably over, discarding likewise all intuitive axioms on the one hand and authority on the other, such as had been the foundation of medeival scholasticism, and appealing by the experimental method, as Dampier-Whetham says in his History of Science, 'to the tribunal of brute facts'- facts which bore no relation to any philosophic synthesis then possible." (3)

Millikan feels that the recent developments in science have tended to increase this emphasis upon empiricism. He continues:

"And here I come to the newer facts of the universe around us which have quite recently taught all physicists, and all mankind, I hope, that the road to fruitful effort lies in sticking close to the scientific method and avoiding extending generalizations into fields beyond those in which experimental observation have demonstrated their

their validity, the method of recognizing and being guide by brute facts whether these fit into general philosophies or not." (4)

Millikan claims that as a

"result, dogmatic materialism in physics is dead. If we had all been as wise as Galileo and Newton it would never have been born, for dogmatism in any form violates the essence of the scientific method, which is to collect with an open mind the brute facts and let them speak for themselves, untrammeled by preconceived ideas, or by general philosophies or universal systems." (5)

Also in "Science and Life", Millikan takes the same general view, saying:

"A science grows in the main as does a planet by the process of infinitesimal accretion. Practically every experiment in physics is a modification of an experiment which has gone before." (6)

Fragmentism in Philosophy

If science thus grows by minute changes brought about under the compulsion of "brute facts", and with "no relation to any philosophic synthesis", it has seemed to some, particularly to Bertrand Russell, and to the Neo-Realists, that philosophy

should grow in the same way.

Joad in his "Philosophical Aspects of Modern Science" says:

> "Modern Realism is a movement of metephysical renunciation. It reconciles itself to the view that philosophy cannot hope to pronounce upon the nature of the universe as a whole, if indeed, the universe can be said to be in any sense a whole of which a nature may be affirmed, and contents itself with a piecemeal investigation of certain particular problems." (7)

Bertrand Russell also takes this position calling his philosophy "Logical Atomism". He says of this Logical Atomism:

> "It represents, I believe, the same kind of advance as was introduced into physics by Galileo: the substitution of piecemeal, detailed, and verifiable results for large untested generalities recommended only by a certain appeal to the imagination." (8)

Nor has this tendency been without effect in theology. There is a school of Neo-Realists in religion, of whom Douglas Clyde Mackintosh is the most outstanding, who evince a general distrust of metaphysics, and who try to find for religion a thoroughly empirical basis.

Another exponent of this point of view is Horton who writes:

"Idealism, as an ally of religion, has been weighed in the balance and found wanting. It is a way that seemeth good unto a man but the end thereof is death." (9)

Theoretical Construction in Science

However all scientists do not agree that modern science is merely a conglomeration of "brute facts". Planck especially devotes a large part of his "Where Is Science Going?" to a discussion and defence of the place of large theoretical constructions in science. In this, he seems to have the sympathy of Einstein, who writes the Introduction to "Where Is Science Going?", and who therein says:

"In every important advance the physicist finds that the fundamental laws are simplified more and more as experimental research advances. He is astonished to notice how sublime order emerges from what appeared to be chaos. And this cannot be traced back to the working of his own mind but is due to a quality that is inherent in the world of perception." (10)

Reichenback claims that there are two opposing tendencies, the one toward a fragmentary way of looking at things, or empiricism; the other toward large "theoretical constructions". He says, speaking of the experiments upon which the New Physics is based:

"The extraordinary significance which the developments of physics attached to these experiments shows clearly the empirical character of modern natural science. The second, equally essential tendency, however, is in the opposite direction; it is disclosed in the method of theoretical construction by which alone the edifice of physical thought is erected. The names of the great branches of the theory of physics are, indeed, sufficient indications of such a way of thinking; the theory of relativity, atomic theory, quantum theory, are theoretical structures which go far beyond the content of immediate observation, and, precisely by so doing, acquire their overwhelming importance. Physics is no collection of facts in spite of all its respect for them; it is a creative construction, based on facts, but, in the implications of its assertions, going far beyond our immediate experience." (11)

It would appear to the layman that the Germans "have right" in their assertion of the importance of theoretical construction in modern

science. Even the electron might seem to be, not so much a "brute fact" as an "inference" from the results of careful experimentation.

Empiricism and Idealism

If there is a place for extendedsystems in science, there is no reason to ask philosophy to give them up, especially if it is willing always to remember the hypothetical nature of all such theoretical constructions. It is at this point that the philosophy of Whitehead differs most markedly from that of Russell. Whitehead feels that philosophy has a right to this larger field.

Reichenbach comments on this problem as follows:

> "Philosophy has always distinguished the two fundamental philosophical attitudes of empiricism and idealism. Empiricism is the doctrine that all knowledge comes from experience, that the propositions of science can, as it were, be read off in the world of experience. Idealism is the conception that thought alone creates

knowledge, that the thinking consciousness really creates its object, leaving to observation with the senses but a subordinate role. It must be said that the natural science of the day has given the victory neither to one of these points of view nor to the other, but rather that its significance lies in a wonderful synthesis of the empiricism -idealism alternative. The fundamental idea of empiricism that only experience can decide on the validity of natural laws, is retained with all its emphasis; but the principle of idealism, that only the combining of observed facts into laws created by thought constitutes science, is equally fundamental for the modern knowledge of nature. Here there is no contradiction. Concepts and relations are creations of thought, but what can tell how concepts and relations must be combined if a picture of the world is to result? Not inner contemplation, but only the questioning of nature with observation and experiment, for the judgment of nature alone can utter the final "yes" or "no." (12)

In the philosophy of Whitehead, a definite place is made both for idealism and for empiricism. The Eternal Objects are of the nature of possibilities which might be gotten at with thought, but only a few of them become actual through the activity of the "Principle of Concretion" or God. This makes necessary the empirical approach. He writes:

"The general principle of empiricism depends upon the doctrine that there is a principle of

concretion which is not discoverable by abstract reason. What further can be known about God must be sought in the region of particular experience, and therefore rests on an empirical basis." (13)

Realism and Idealism

Some thinkers believe that the antithesis is between Realism and Idealism also is solved by the philosophical implications of modern science. The breakdown of matter into energy must necessarily change one's view of the nature of reality, and if reality is mental, as Jeans and Eddington maintain, the distinction "becomes blurred". On this matter Jeans says:

"If it is true that the 'real essence of substances' is beyond our knowledge, then the line of demarcation between realism and idealism becomes very blurred indeed; it is little more than a relic of a past age in which reality was believed to be identical with mechanism. Objective realities exist because certain things affect your consciousness and mine in the same way, but we are assuming something we have no right to assume if we label them as either 'real' or 'ideal'."

The true label is "mathematical".

"Such a label does not imply anything as to what things are in their ultimate essence, but

merely something as to how they behave." (14)

Bertrand Russell also feels that both mind and matter are merely "events" organized upon slightly different plans, and much as he sympathizes with the position of the Neo-Realists, he refuses to be listed among them , because he feels that the distinction between Realism and Idealism is out of date, and a mere ghost of a division that was real, before modern developments in science changed our view as to the nature of reality.

The Philosophy of Organism

In the recent changes in the exact sciences, there have been a number of interesting facts which might point toward another interpretation of the universe as a whole than the mechanical one which was so popular in the past, and especially might point toward a more organic kind of universe.

In the first place, mechanism has lost its place of pre-eminence. In the past, as Lyman points out, cosmologies have commonly been organized on the three analogies of (1)mechanism, (2)organism, (3)purpose. With the first out of the way, the way is cleared for the other two.

Again the principle of indeterminacy and other factors have indicated that the individual atoms and electrons do not follow the same laws as do "aggregates of matter".

Once more the fact that light and radiation always goes in units has led to some interesting speculations. We all know that however highly charged a carrier of electricity may be, a spark will not jump out until a place is found for it in another carrier of electricity less fully charged. Electricity never jumps out into space, but always to another conductor. Similarly it is difficult to understand how the bullets of radiation don't get mixed up unless a bullet of

radiation before it leaves one position has its new position already picked out. But this would be an inter-relation between parts, which could be unthinkable on the basis of the old mechanical view. The idea that the ray of light from a star hundreds of light-years away, could not leave that star to come to earth without there already being foreseen that a place for its radiation existed here, is a concept of the whole controlling the parts with a vengeance.

As Lyman points out:

"A good definition of the distinction between a mechanism and an organism has been given by Hobhouse. He points out that in a mechanism the parts are mutually indifferent to each other, while in an organism the parts form a sympathetic whole." (15)

Whitehead has been so impressed by this implication of the new knowledge, that he calls his philosophy a philosophy of organism. In this regard, he says that besides the primary organisms:

"There are also organisms of organisms. Suppose for the moment and for the sake of

simplicity, we assume, without any evidence, that electrons and hydrogen nuclei are such basic organisms. Then the atoms, and the molecules, are organisms of a higher type, which also represent a compact definite organic unity. But when we come to the larger aggregations of matter, the organic unity fades into the background. It appears to be but faint and elementary. It is there; but the pattern is vague and indecisive. It is a mere aggregation of effects. When we come to living beings, the definiteness of pattern is recovered, and the organic character again rises into prominence. Accordingly, the characteristic laws of inorganic matter are mainly the statistical averages resulting from confused aggregates. So far are they from throwing light on the ultimate nature of things, that they blur and obliterate the individual characters of the individual organisms. If we wish to throw light upon the facts relating to organisms, we must study either the individual molecules and electrons, or the individual living things. In between we find comparative confusion." (16)

So impressed is Whitehead with the organic and social nature of reality that he concludes:

"There is no entity, not even God, which requires nothing, but itself in order to exist.... Every entity is in its essence social and requires the society in order to exist. In fact, the society for each entity, actual or ideal, is the all-inclusive universe, including its ideal forms." (17)

As Lyman says:

"The position that wholes can determine parts as well as parts wholes, and that for the understanding

of living organisms efficient causation and final causation must be interwoven, makes a fuller synthesis of the facts of experience than the position that the laws of physical and chemical combination are our sufficient and sole sources for the explanation of living bodies." (18)

The Religious Implications of the Organic View of the Universe

The overwhelming importance of the organic view of the universe to religion and morality is obvious. It is undoubtedly true, as Brightman says, that religion is compatible with many different kinds of philosophy or with no philosophy at all, yet it is also true as Horton says in his "Psychological Approach to Religion" that there is a tendency for persons to make their philosophies of life, and their view of the universe as a whole, agree, so that even the Communist, when hard pressed, is likely to bang the table and to affirm that "there is something in the Nature of things, that makes for the Communist ideal".

Now morality and religion are essentially the working out in actual life of the idea that:

"There is a Destiny that makes us brothers,
None goes on his way alone;
The things we put into the lives of others
Come back into our own".

Christian religion and morality arose in an atmosphere in which Paul could write:

"For as the body is one, and hath many members of the body, being many, are one body; so also is Christ. For in one Spirit were we all baptized into one body, whether Jews or Greeks, whether bond or free; and were all made to drink of one Spirit. For the body is not one member, but many. If the foot shall say, Because I am not the hand, I am not of the body; it is not therefore not of the body. And if the ear shall say, Because I am not the eye, I am not of the body; it is not therefore not of body. If the whole body were an eye, where were the hearing? If the whole were hearing, where were the smelling? But now hath God set the members each one of them in the body, even as it pleased him. And if they were all one member, where were the body? B ut now they are many members, but one body. And the eye cannot say to the hand, I have no need of thee; or again the head to the feet, I have no need of you..... The members should have the same care one for another. And whether one member suffereth, all the members suffer with it; or one member is honored, all the members rejoice with it. Now ye are the body of Christ, and severally members thereof." (19)

And in a thought-world which is mechanical and individualistic, they persist only as ghosts of the former organic view of the world, and as ghosts, they become paler and paler. Morality shrinks to hedonism, and religion to the pious selfishness of some forms of the so-called "individual gospel". War and social injustice are rampant and it is believed that they are natural and that religion has nothing to do with them. The whole intellectual atmosphere is a perfect environment for the growth of evil and strife.

A certain Methodist bishop was once asked what became of the dinosaurs, and the other ancient amphibians, and he replied "the climate changed, and they died".

The intellectual climate changed to a mechanical individualism, and Christianity began to die. Now it appears as if the newer findings of science will change the intellectual climate back to an organic view of the universe, similar to the one out of

which Christianity arose, and in the new climate it may be expected that it will be the monsters of greed and militarism, which will sicken and die, whereas religion and morality will grow, and blossom like the rose.

In the philosophy of Whitehead, the conception of God as the Principle of Concretion is sufficient for the uses of philosophy, but when he turns to religion, he begihs to think of God as the source of the organic unity of the universe, and as the source of the social bond, and as the source of values. He writes:

"God is the one systematic complete fact, which is the antecedent ground conditioning every creative act.

"God in the world is the perpetual vision of the road which leads to the deeper realities.

"God is that function in the world by reason of which our purposes are directed to ends which in our own consciousness are impartial as to our interests.

"He is that element in life in virtue of which judgment stretches beyond facts of existence to values of existence. He is that element in virtue of which our purposes extend beyond values for ourselves to values for others. He is that element in virtue of which the attainment of such

a value for others transforms itself into value for ourselves.

"He is the binding element in the world. The consciousness which is individual in us, is universal in him. The love which is partial in us is all-embracing in him. Apart from him there could be no world, because ther could be no adjustment of individuality. God - upon whose wisdom all forms of order depend." (20)

Close

We have come to the close of our discussion of the effects of the new science upon our religious thought. We have seen the beginning of many effects, some of which are not compatible with the others. However we must remember that the full influence of the new facts have not been felt. It is to be remembered also that the ultimate results of the theory of evolution were quite different, in their effects upon religious thought, than was foreseen by the rank and file, who seized upon superficial aspects of the new system. Similarly it is very possible that we are as yet only dealing with the superficial aspects of the new knowledge

in our long discussions, say of causality, and that the ultimate effects lie in the lap of the future. In this regard, it seems to be true that although logic gives a very low standing to analogy as a method of ascertaining tmuth, yet in the long run, human beings accept as true that which is similar to what they already believe, and so we may expect analogy and not logic to be the major factor in making these changes. Perhaps if all knowledge is symbolic in character, this is the way that it should be.

It is probable that a distinction in religion analogous to that which Hartley Burr Alexander makes in science, could be made, dividing religion into

(1) Religion as a fetich,

(2) Religion as a system of belief,

(3) Religion as a way of life.

The new knowledge will not affect the first, except to further accentuate the fact that it is an anachronism. In the future as in the past, we may expect such things as Sabbath observation, Church attendance, the eating of fish on Friday, and the refusal to eat pork on any day to persist, not as means to any greater end, but as ends in themselves.

It is religion as a system of beliefs that we may expect to see changed, demolished, constructed, and reconstructed by the new findings of science. However, as Julian Huxley says:

"We can no longer look on religions as fixed; there is a development in religion as there is in law or science or political institutions." (21)

The reason that these changes seem so fearful to us is because

"The system of ideas and explanations and reasonings which crystallizes out as a theology tends to become tinged with the feeling of sacredness which is at the heart of religion... They become an integral part of the particular religion at its particular stage of development.... science can be in conflict with particular stages of particular religions, though it cannot possibly be in conflict with religion in general." (22)

"One who is afraid of truth does not believe in God". We must welcome progress in our religious ideas. As Whitehead says:

> "Consider the contrast: when Darwin or Einstein proclaim theories which modify our ideas, it is a triumph for science. We do not go about saying that there is another defect for science because its old ideas have been abandoned. We know that another step of scientific insight has been gained.
>
> "Religion will not regain its old power until it can face change in the same spirit as does science. Its principles may be eternal, but the expression of these principles requires continual development." (23)

We may be truly thankful that our systems of religious thought are constantly changing, progressing, fitting themselves into the temper of the times, and generally making themselves more helpful to the religious life.

And now we come to the essence of religion as a way of life, the thing that Micah tried to sum up in "justice and kindliness and the humble walking with our God". (24) This is something eternal, which the winds of doctrine cannot change.

And yet there is something in the new developments of science, with their revelation of the deep mysteriousness of nature, of the symbolical nature of our knowledge, of the existence of some Universal Mind or Logos, and of the organic and social nature of the universe, which reminds one of the words which the Author of the Fourth Gospel puts into the mouth of the Eternal Logos:

> "I am the true vine, and my Father is the husbandman. Every branch in me that beareth not fruit, he taketh it away; and every branch that beareth fruit, he cleanseth it, that it may bear more fruit. Already ye are clean because of the word which I have spoken unto you. Abide in me, and I in you. As the branch cannot bear fruit of itself, except it abide in the vine, ye are the branches; He that abideth in me, and I in him, the same beareth much fruit; for apart from me ye can do nothing." (25)

for they seem to reveal God as the source of a bond of brotherhood uniting all mankind.

Notes

Chapter I

1 - Cardinal John Henry Newman, quoted in:
Andrew D. White, - History of the Conflict of Science with Theology
Vol. I page 166

2 - Upton Sinclair, - The Profits of Religion

3 - Hans Reichenbach, - Atom and Cosmos, page 288

4 - Bertrand Russell, - Principles of Philosophy, page 229

5 - Ibid, pg 229

6 - Bertrand Russell, - A.B.C. of Relativity

7 - Alfred North Whitehead, - Science and the Modern World, pg. 251

8 - Ibid, pg 250

9 - Ibid, pg 257

9A - Edouard LeRoi, - Le Probleme de Dieu

10 - Walter Marshall Horton, - Theism and the Scientific Spirit, pg 164

11 - Ibid, pg 169

12 - Ibid, pg 168

13 - Ibid, pg 172

14 - Ibid, pg 174

15 - Arthur Stanley Eddington, - The Nature of the Physical World, pg 338

16 - W alter Marshall Horton, - Theism and the Scientific Spirit, pg 178

17 - Ibid, pg 179

18 - Ibid, pg 184 (Art. XXVI in the Syllabus of Pius X)

19 - John Wright Buckham, - T he Humanity of God, pg 17

20 - Sir James Jeans, - The Mysterious Universe, pg 160

21 - Ibid, pg 157

22 - Ibid, pg 158

23 - Ibid, pg 159

24 - Ibid, pg 1[illegible]

25 - Ibid, pg 180

26 - Daniel Arthur McGregor, - in an article, "A Believer in Churchia[illegible]" in Contemporary American Theology, Second Series, edited by Virgilius Ferm. pg 143

27 - Ibid, pg 148

Notes

Chapter II

1 - Eugene William Lyman, - The Meaning and Truth of Religion, pg 262

2 - Ibid, pg 262 This is a quotation from Stanley Arthur Eddington, The Nature of the Physical World, pg 252

3 - Ibid, pg 301

4 - Stanley Arthur Eddington, - The Nature of the Physical World, pg 331

5 - Ibid, pg 254

6 - Ibid, pg 275

7 - Ibid, pg 329

8 - Ibid, pg 344

9 - Sir James Jeans, - The Mysterious Universe, pg 131

10 - Ibid, pg 135

11 - Ibid, pg 135

12 - Ibid, pg 151-152

13 - Ibid, pg 152

14 - John Wright Buckham, - The Humanity of God, pg 29

Notes

Chapter III

1 - Sir James Jeans, - The New Background of Science, pg 231, 232

2 - Eugene W illiam Lyman, - The Meaning and Truth of Religion, pg 265

3 - Ibid, pg 267

4 - Bertrand Russell, - Philosophy, pg294

5 - Alfred North Whitehead, - Science and the Modern World, pg 156

6 - Eugene William Lyman, - The Meaning and Truth of Religion, pg 267

7 - Ibid, pg 268, A quotation from Eddington's Nature of the Physical World, pg 220

8 - Ibid, pg 263

9 - Hans Reichenbach, - Atom and Cosmos, pg 267

10 - Ibid, pg 270

11 - Ibid, pg 275

12 - Ibid, pg 278

13 - Ibid, pg 279

14 - Robert Andrews Millikan, - Time, Matter, and Values, pf 96

15 - Bertrand Russell, - The A.B.C. of Relativity, pg 224

16 - Max Planck, - The Universe in the Light of Modern physics, pg 51

17 - Ibid, pg 89

18 - Ibid, pg 91

19 - Arthur Stanley Eddington, - The Nature of the Physical World, pg 98

20 - Ibid, pg 294

21 - Ibid, pg 295

22 - Ibid, pg 310

23 - Ibid, pg 331

[illegible] - Ibid, pg [illegible]

[illegible] - [illegible], - The Mysterious Universe, pg 134

28 - Sir James Jeans, - The New Background of Science, - pg 236

[illegible] - Ibid, pg 256. This is a quotation from Heisenberg's "The Physical Principles of the Quantum Theory", pg 65

[illegible] - Ibid, pg 259

[illegible] - Ibid, pg 278. A quotation from Planck's "W here Is Science Going", pg 143, 155

30 - Arthur Stanley Eddington, - The Nature of the Physical World, pg 295

31 - Walter Marshall Horton, - Theism and the Scientifid Spirit, pg 171, 172

Chapter V

1 - Sir James Jeans, - The Mysterious Universe, pg 135, 136

2 - Ibid, pg 137, 138

3 - Ibid, pg 140

4 - Ibid, pg 144

5 - Ibid, pg 140

6 - Ibid, pg 144

7 - Ibid, pg 145

8 - Ibid, pg 146

9 - Ibid, pg 147

10 - Ibid, pg 150

11- Ibid, pg 154

12 - Ibid, pg 158

13 - Bertrand Russell, - The Outline of Philosophy, pg 311

14 - Bertrand Russell, - The A.B.C. of Relativity, pg 226

15 - Arthur Stanley Eddington, - The Nature of the Physical World, pg 276

16 - Ibid, pg 283

17 - Ibid, pg 330

18 - Ibid, pg 331

19 - Ibid, pg 338

20 - Eugene William Lyman, - The Meaning and Truth of Religion, pg 284

21 - Ibid, pg 286

Chapter VI

1 - Arthur Stanley Eddington, - The Nature of the Physical World, pg 288

2 - Ibid, pg 331

3 - Ibid, pg 333

4 - Ibid, pg 337

5 - Ibid, pg 341

6 - Max Planck, - The Universe in the Light of Modern Physics, pg 113

7 - C.E.M. Joad, - Philosophical Aspects of Modern Science, pg 339

8 - Ibid, pg 324

9 - Ibid, pg 314

10 - Ibid, pg 325

Chapter VII

1 - Arthur Stanley Eddington, - The Nature of the Physical World, pg 347

2 - Julian Huxley in A Symposium - Science and Religion, pg 18

3 - Robert Andrews Millikan, - Time Matter, and Values, pg 75

4 - Ibid, pg 93

5 - Ibid, pg 96

6 - Robert Andrews Millikan, - Science and Life, pg 15

7 - C.E.M. Joad, - Philosophical Aspects of Modern Science, pg 338

8 - Bertrand Russell, - Our Knowledge of the Ecternal World, pg 4

9 - Walter Marshall Horton, - a paper in Douglas Clyde Macintosh (Ed) Religious Realism, - pg 177

10 - Albert Einstein, - Introduction to Max Planck - Where is Science Going? pg 11

11 - Hans Reichenbach, - Atom and Cosmos, pg 281

12 - Ibid, pg 282

13 - Alfred North Whitehead, - Science and the Modern World, pg 257

14 - Sir James Jeans, - The Mysterious Universe, pg 148

15 - Eugene William Lyman, - The Meaning and Truth of Religion, pg 269

16 - Alfred North Whitehead, Science and the Modern World, pg161

17 - Alfred North Whitehead, - Religion in the Making, pg 108

18 - Eugene William Lyman, - The Meaning and Truth of Religion, pg 275

19 - Paul, - 1st Corinthians 12

20 - Alfred North Whitehead, Religion in the Making, pg 158

21 Julian Huxley, - A Symposium - Science and Religion, pg 18

22 - Ibid, pg 18

23 - Alfred North Whitehead, - Science and the Modern World, pg 273

24 - Micah 6 8

25 - 4th Gospel, - 15 1-5

Bibliography

Eddington, Arthur Stanley, -- The Nature of the Physical World
Science and the Unseen World

Einstein, Albert, -- Sidelights on Relativity

Haldane, Viscount, -- The Reign of Relativity

Horton, Walter Marshall, -- Theism and the Scientific Spirit
Article in Contemporary American Theology, Second Series

McGregor, Daniel Arthur, -- an article in Contemporary American Theology, Second Series

Inge, W.R., -- Science and Ultimate Truth

Jeans, Sir James, -- The Mysterious Universe
The New Background of Science

Joad, C.E.M., -- Philosophical Aspects of Modern Science

Keyser, Cassius Jackson, -- Humanism and Science

Lyman, Eugene William, -- The Meaning and Truth of Religion

Mathews, Shailes, -- Contributions of Science to Religion

McConnell, Francis John, -- Is God Limited?

Millikan, Robert Andrews, -- Time, Matter, and Values
Science and Life

Planck, Max, -- The Universe in the Light of Modern Physics
Where is Science Going?

Pupin, Michael, -- The New Reformation
A Symposium on Science and Religion

Reichenbach, Hans, -- Atom and Cosmos

Russell, Bertrand, -- A.B.C. of Atoms
A.B.C. of Relativity
Problems of Philosophy
Our Knowledge of the External World
Philosophy

Slosson, Edwin E., -- The Contributions of the New Physics to Religion

White, Andrew Dickson, -- The History of the Conflict of Science With Theology

Whitehead, Alfred North, -- Science and the Modern World
Religion in the Making

GTU Library
3 2400 00670 9012

LIBRARY USE ONLY

GTU Library
2400 Ridge Road
Berkeley, CA 94709
For renewals call (510) 649-2500
All items are subject to recall